

**GENERAL
INSTRUMENT**

**VSM2032
VOICE SYNTHESIS
MODULE
USER'S GUIDE**

Microelectronics Division
General Instrument Corporation
600 West John Street
Hicksville, New York 11802

Printed in U.S.A.

- Complete Speech System
- Stores approximately 30 Seconds of Speech
- 32 Words and Syllables Combine to Form Over One Billion Phrases
- Custom Vocabularies Available
- Simple Digital Interface (TTL)
- 5 Volt Power Supply ($\pm 5\%$)
- Audio Output: 200mw
- Operating Temperature 0° to 70°C
- Dimensions: 3.25" x 5.0"

The VSM2032 utilizes General Instrument's state-of-the-art technology to synthesize speech. The module contains three MOS/LSI devices fabricated with N-Channel Ion Implant Processing resulting in a high performance product with proven reliability and production history. The module interfaces easily to any digital system; eight TTL compatible signals are used to select the phrase to be spoken. Once selected, the VSM2032 requires no support from the user's circuit. It enunciates the phrase and signals when complete.

The VSM2032 is interfaced using a 15-pin card edge connector (Amphenol 225-21521-401 (117) or equivalent). The phrase to be spoken is selected with a 7-bit address (S_0 - S_6). This data is strobed into the module using STROBE. The module will drive the busy line (BUSY) low while it is speaking. During this time, new data will not be accepted.

The module is initialized by applying two low pulses to the $\overline{\text{RESET}}$ pin.

The audio output is available on both the card edge connector and on the module. It is designed to drive an 8 Ω load with 200 mw of power.

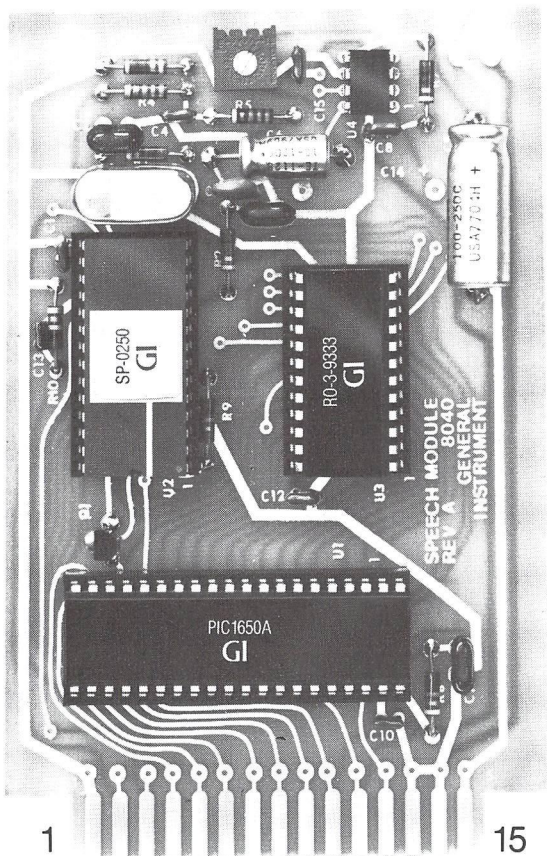
The standard VSM2032 can enunciate the thirty-two words and syllables listed below. Alternate vocabularies are available (contact regional sales office for information).

Numbers less than one billion can be enunciated using this phrase set. For example, 1214.1 would be generated by concatenating the following phrases:

| | | | | | | | |
|----------------|-----------------|----------------|-----------------|----------------|-----------------|-----------------|----------------|
| ONE | THOUSAND | TWO | HUNDRED | FOUR | TEEN | POINT | ONE |
| 1 ₈ | 16 ₈ | 2 ₈ | 15 ₈ | 4 ₈ | 24 ₈ | 32 ₈ | 1 ₈ |

Addresses 40₈-177₈ are not used with this phrase set. The VSM2032 will lock up if invalid addresses are used.

| ADDRESS | | | | | | | | | ADDRESS | | | | | | | | |
|---------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------|---------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|--------|
| Octal | S ₆ | S ₅ | S ₄ | S ₃ | S ₂ | S ₁ | S ₀ | Phrase | Octal | S ₆ | S ₅ | S ₄ | S ₃ | S ₂ | S ₁ | S ₀ | Phrase |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | ZERO | 20 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | TWEN |
| 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | ONE | 21 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | THIR |
| 2 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | TWO | 22 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | FIF |
| 3 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | THREE | 23 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | TY |
| 4 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | FOUR | 24 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | TEEN |
| 5 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | FIVE | 25 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | PLUS |
| 6 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | SIX | 26 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | MINUS |
| 7 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | SEVEN | 27 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | TIMES |
| 10 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | EIGHT | 30 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | OVER |
| 11 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | NINE | 31 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | EQUALS |
| 12 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | TEN | 32 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | POINT |
| 13 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | ELEVEN | 33 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | ERROR |
| 14 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | TWELVE | 34 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | IT IS |
| 15 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | HUNDRED | 35 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | AM |
| 16 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | THOUSAND | 36 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | PM |
| 17 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | MILLION | 37 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | OH |



| Pin | Signal | Function |
|-----|----------------------------|---|
| 1 | V_p | 5 Volt DC Regulated $\pm 5\%$ |
| 2 | — | No Connection |
| 3 | $\overline{\text{RESET}}$ | Initializes Module, Active Low |
| 4 | S_0 | Phrase Address Bit 0 (LSB) |
| 5 | S_1 | Phrase Address Bit 1 |
| 6 | S_2 | Phrase Address Bit 2 |
| 7 | S_3 | Phrase Address Bit 3 |
| 8 | S_4 | Phrase Address Bit 4 |
| 9 | S_5 | Phrase Address Bit 5 |
| 10 | S_6 | Phrase Address Bit 6 (MSB) |
| 11 | $\overline{\text{BUSY}}$ | Indicates Module is Speaking (Active Low)* |
| 12 | $\overline{\text{STROBE}}$ | Strobes Phrase Address |
| 13 | GND | Power Supply Ground |
| 14 | SPKRET | Audio Return. Must Be Connected to Logic Ground |
| 15 | SPK | Audio Output |

*The $\overline{\text{BUSY}}$ signal is used as an input in the test mode. During reset the test mode will be entered if this line is low (logic zero). Make no connections to active pins on the non-component side of board. These signals are for test purposes only.

Maximum Ratings*

| | |
|--|-----------------|
| Temperature Under Bias | 125°C |
| Storage Temperature | −55° to +150°C |
| Voltage on any pin with respect to GND | −0.3V to +12.0V |
| Power Dissipation | 1W |

* Exceeding these ratings could cause permanent damage to the device. This is a stress rating only and functional operation of this device at these conditions is not implied. Operating ranges are specified in Standard Conditions. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

Standard Conditions (unless otherwise stated):

DC CHARACTERISTICS

Operating Temperature $T_A = 0^\circ\text{C}$ to $+70^\circ\text{C}$

| Characteristic | Sym | Min | Typ | Max | Units | Conditions |
|-----------------------------|-----------|-----------|------|-------|-------|---|
| Supply Voltage | V_p | 4.75 | — | 5.25 | V | Audio Off |
| Supply Current | I_p | — | 100 | 170 | mA | |
| S_0 - S_6 Low Voltage | V_{IL1} | −0.2 | — | 0.8 | V | |
| S_0 - S_6 High Voltage | V_{IH1} | 2.4 | — | V_p | V | |
| RESET & STROBE Low Voltage | V_{IL2} | −0.2 | — | 0.8 | V | |
| RESET & STROBE High Voltage | V_{IH2} | V_{p-1} | — | V_p | V | $I_{OL} = 1.6\text{mA}$ (NOTE 1) $I_{OH} = -100\mu\text{A}$ |
| BUSY Output Low Voltage | V_{OL} | — | — | 0.8 | V | |
| BUSY Output High Voltage | V_{OH} | 2.4 | — | V_p | V | |
| Input Low Current | I_{IL} | −0.2 | −0.6 | −1.6 | mA | |
| Input High Current | I_{IH} | −0.1 | −0.4 | — | mA | |
| Audio Output | A_p | — | — | 200 | mW | $V_{IH} = 2.4\text{V}$ $8\Omega\text{LOAD}$ |

NOTE:

1. Positive current indicates current into module. Negative current indicates current out of module.

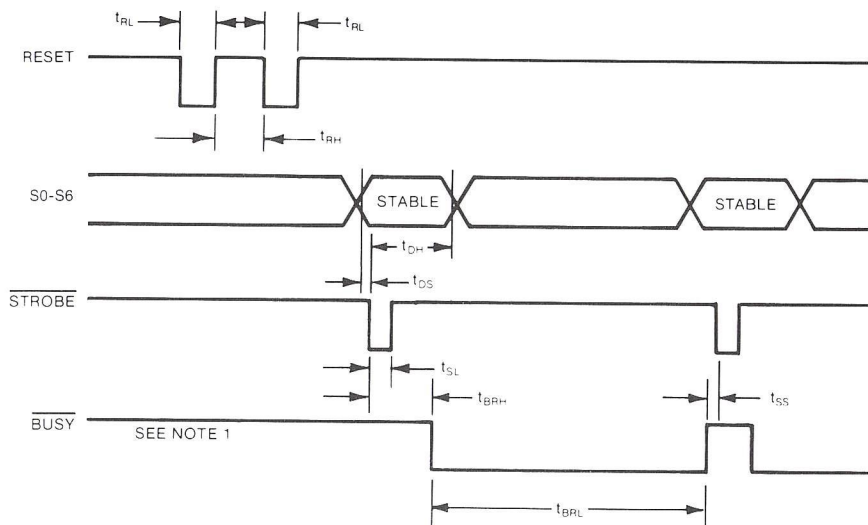
Standard Conditions (unless otherwise stated):

AC CHARACTERISTICS

Operating Temperature $T_A = 0^\circ\text{C}$ to $+70^\circ\text{C}$

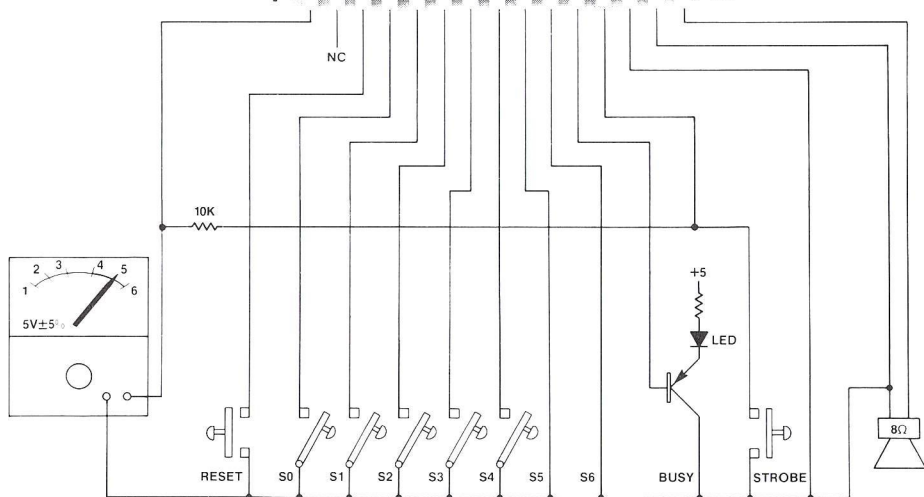
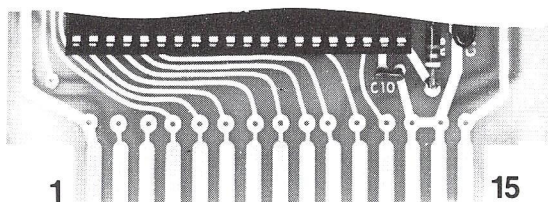
| Characteristic | Sym | Min | Typ | Max | Units | Conditions |
|-------------------------|-----------|-----|-----|-----|---------------|--------------------------------|
| RESET Low Time | t_{RL} | 5 | — | — | μs | Two resets are required. |
| RESET High Time | t_{RH} | 200 | — | 500 | μs | |
| Data Hold Time | t_{DH} | 50 | — | — | μs | |
| Data Setup Time | t_{DS} | 0 | — | — | ns | |
| BUSY Response Time High | t_{BRH} | — | — | 40 | μs | |
| STROBE Setup Time | t_{SS} | 0 | — | — | ns | Determined by Length of Phrase |
| STROBE Low Time | t_{SL} | 5 | — | — | μs | |
| BUSY Response Time Low | t_{BRL} | — | — | — | — | |

TIMING DIAGRAM



NOTE:

1. The BUSY line (used as an input for testing) must be high (logic One) during RESET.

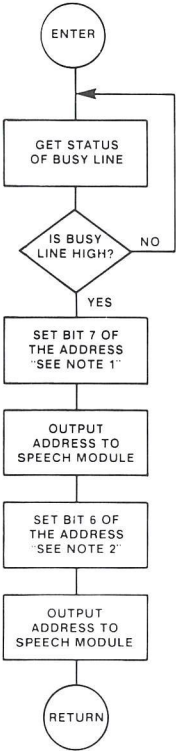


The VSM2032 can be easily interfaced to a parallel port on any computer or microprocessor system. The TRS-80™ Model 1 personal computer is used as an example of this operation.

| VSM2032 CONN. | TRS80 LINE PRINTER CONN. | ADDITIONAL CONNECTIONS |
|------------------|--------------------------|------------------------|
| 1 V_p | — | +5V $\pm 5\%$ |
| 2 <u>RESET</u> | — | — |
| 3 S0 | 17 DATA 8 | — |
| 4 S1 | 3 DATA 1 | — |
| 5 S2 | 5 DATA 2 | — |
| 6 S3 | 7 DATA 3 | — |
| 7 S4 | 9 DATA 4 | — |
| 8 S5 | 11 DATA 5 | — |
| 9 S6 | 13 DATA 6 | — |
| 10 <u>BUSY</u> | — | GND |
| 11 <u>STROBE</u> | 21 BUSY | — |
| 12 GND | 15 DATA 7 | — |
| 13 SPKRET | 2 GND | GND |
| 14 SPR | — | GND |
| 15 | — | 8Ω SPEAKER |

This routine interfaces the TRS-80 Model 1 to the VSM2032 speech module through the parallel printer port.

The routine waits for the busy line to go high (speech module not talking) and then outputs the address of a phrase to the speech module.



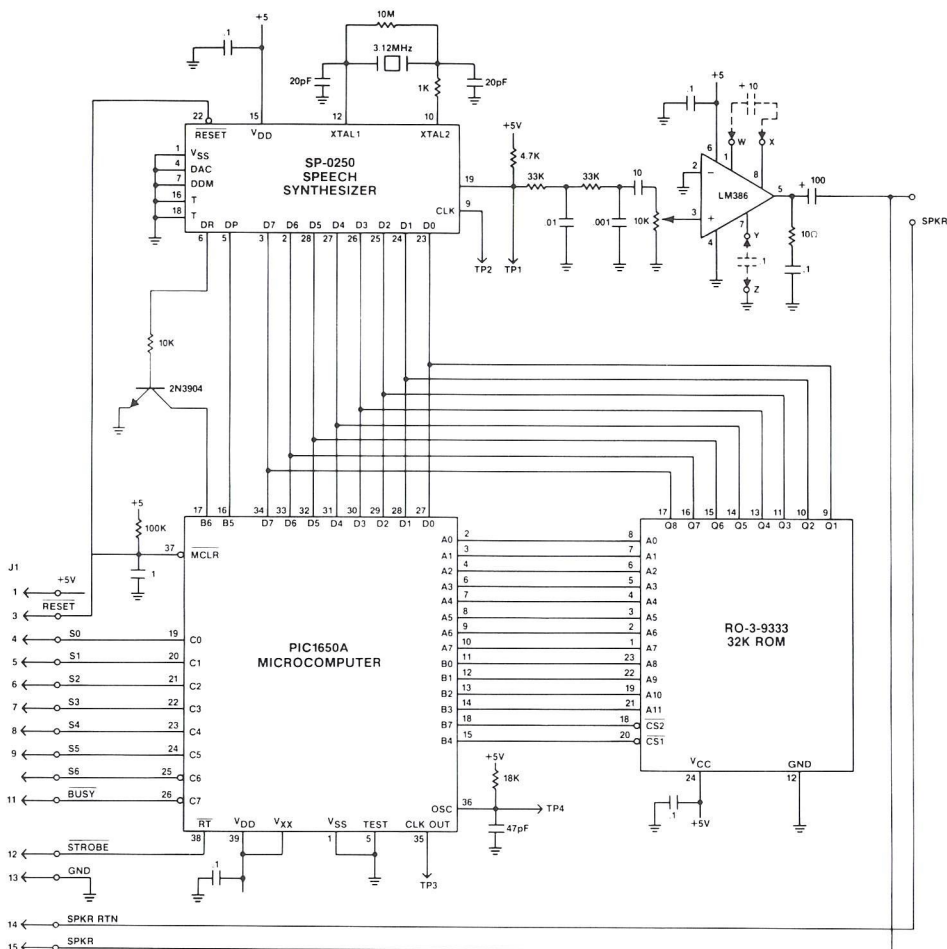
- Note 1: Calling program must reset speech module by outputting two successive low to high transitions on pin D₈ of parallel port.
- Note 2: A high to low transition on D₇ strobes the address into the speech module.

These four statements will reset the speech module.

```
510 POKE 14312,64
520 POKE 14312,192
530 POKE 14312,64
540 POKE 14312,192

795 REM OUTPUT ADDRESSES TO SPEECH MODULE
800 XB = PEEK (14312)
810 IF XB <128 THEN GOTO 800
820 XA(XI) = XA(XI) +128
830 XC% = XA(XI)
840 POKE 14312,XC%
850 XA(XI) = XA(XI) +64
860 XC% = XA(XI)
870 POKE 14312,XC%
880 RETURN
```

- XA: Array—stores the addresses
XI: Index to XA array
XB: Busy yes/no
XC%: Stores one character from XA array



NOTES:

1. J1 mates to Amphenol connector 225-21521-401(117).
2. Capacitors shown as dotted lines on LM386 can be added to increase gain.
3. All capacitor values are μF except where noted.
4. SPKR RTN must be tied to System Logic Ground.

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